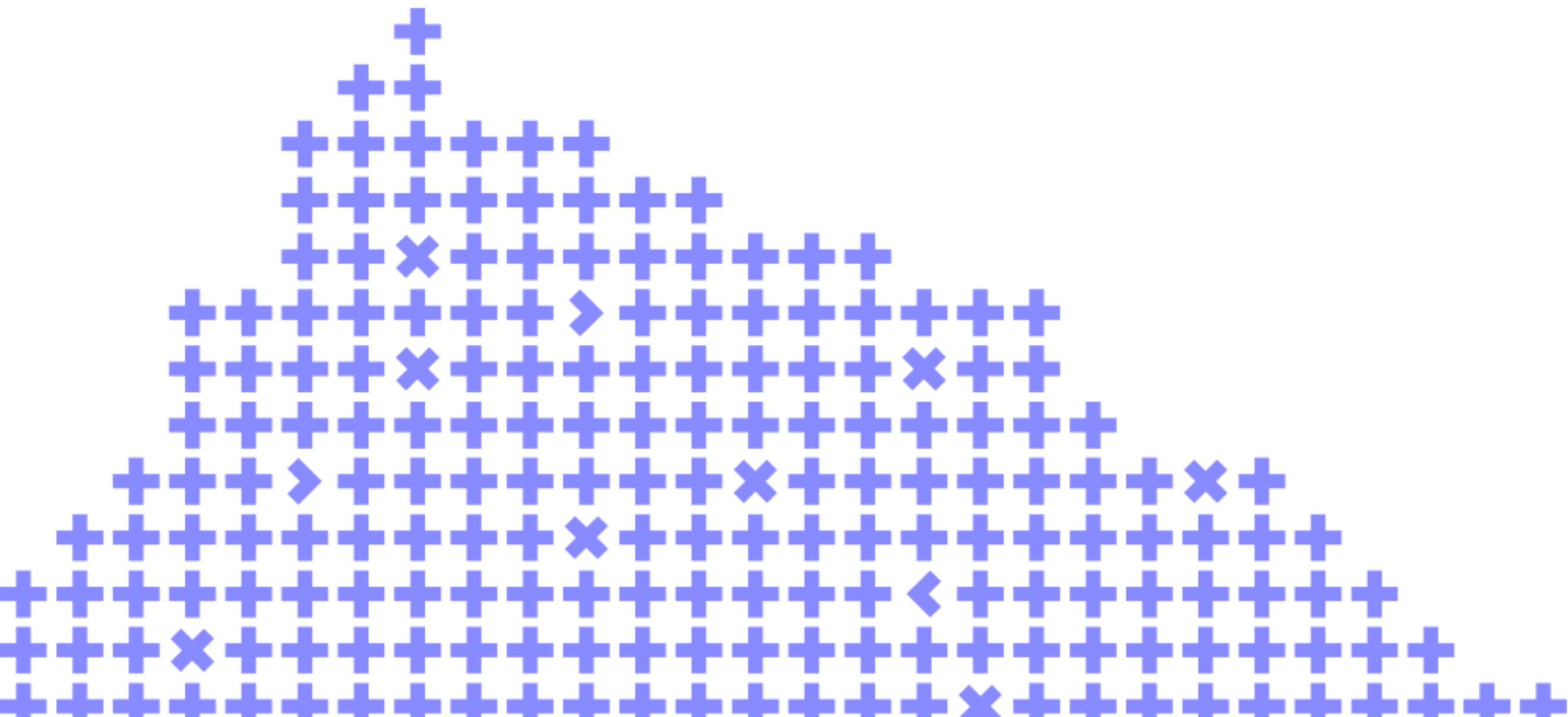


# Things they never tell you about video streaming

Anton Kortunov



Co-organizer

**Yandex**



# Yandex

Modern history of Yandex  
live streaming services

2019

## NHL

Stream all games (up to 13 at the same time)

Deep integration with professional TV studio

2018

## FIFA World cup

1 TBps of video

1M of viewers online

2018

## Winter Olympic Games

The first major live event

2017

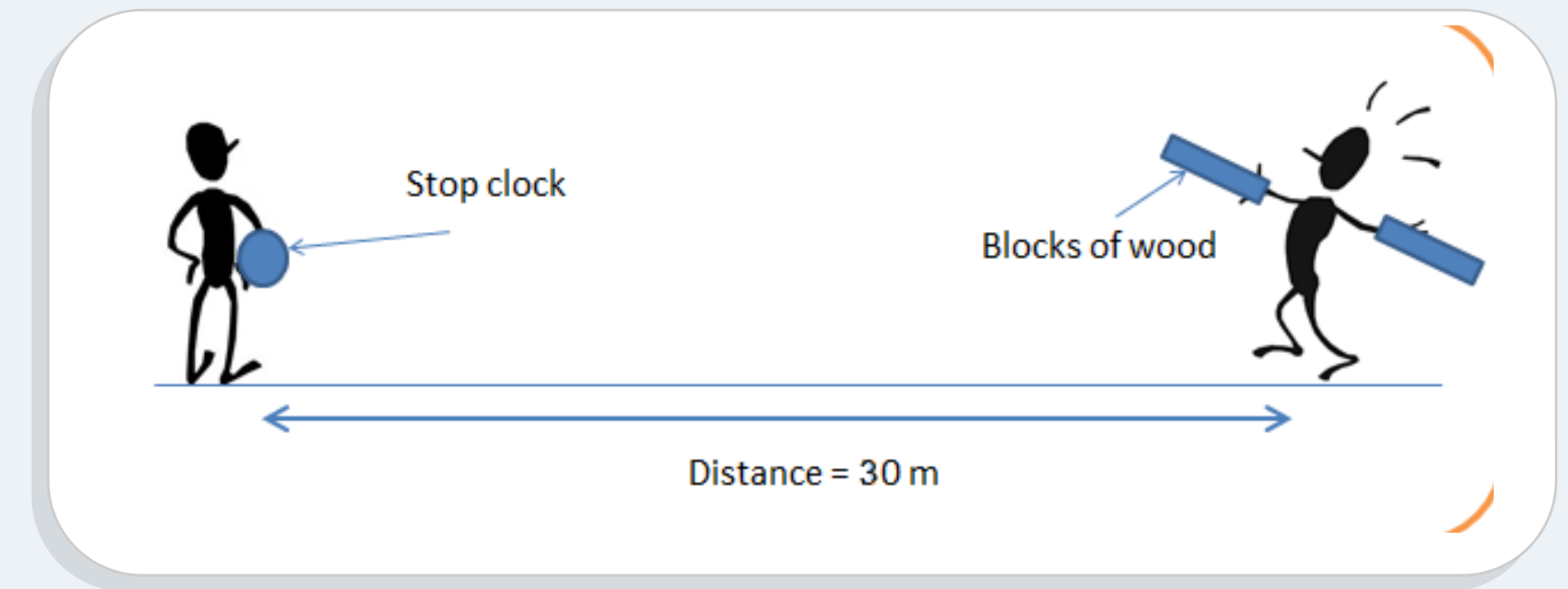
## Start of Yandex Efir project

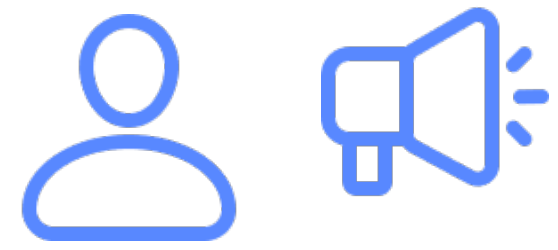
Live TV channels



1. Why does sound matter?
2. Why does shutter matter?
3. Interlaced videos
4. Frame Rate Conversion
5. How to preserve quality?

Speed of sound is  $\sim 340$  m/s  
100 m/s delay equals to  $\sim 30$  m





## Lip sync

- OK if audio delays from video, up to 4 frames
- Not OK if video delays from audio, no more than 1 frame allowed







1. Why does sound matter?
2. Why does shutter matter?
3. Interlaced videos
4. Frame Rate Conversion
5. How to preserve quality?



# How to control Exposure Value

1

---

Aperture

2

---

Shutter speed

3

---

ISO

4

---

ND filters

Video is not a  
sequence of images!  
Motion blur matters!

# How to control Exposure Value

1

---

Aperture

2

---

Shutter speed

3

---

ISO

4

---

ND filters

# How to control motion blur

Minimal motion blur (stuttered motion)

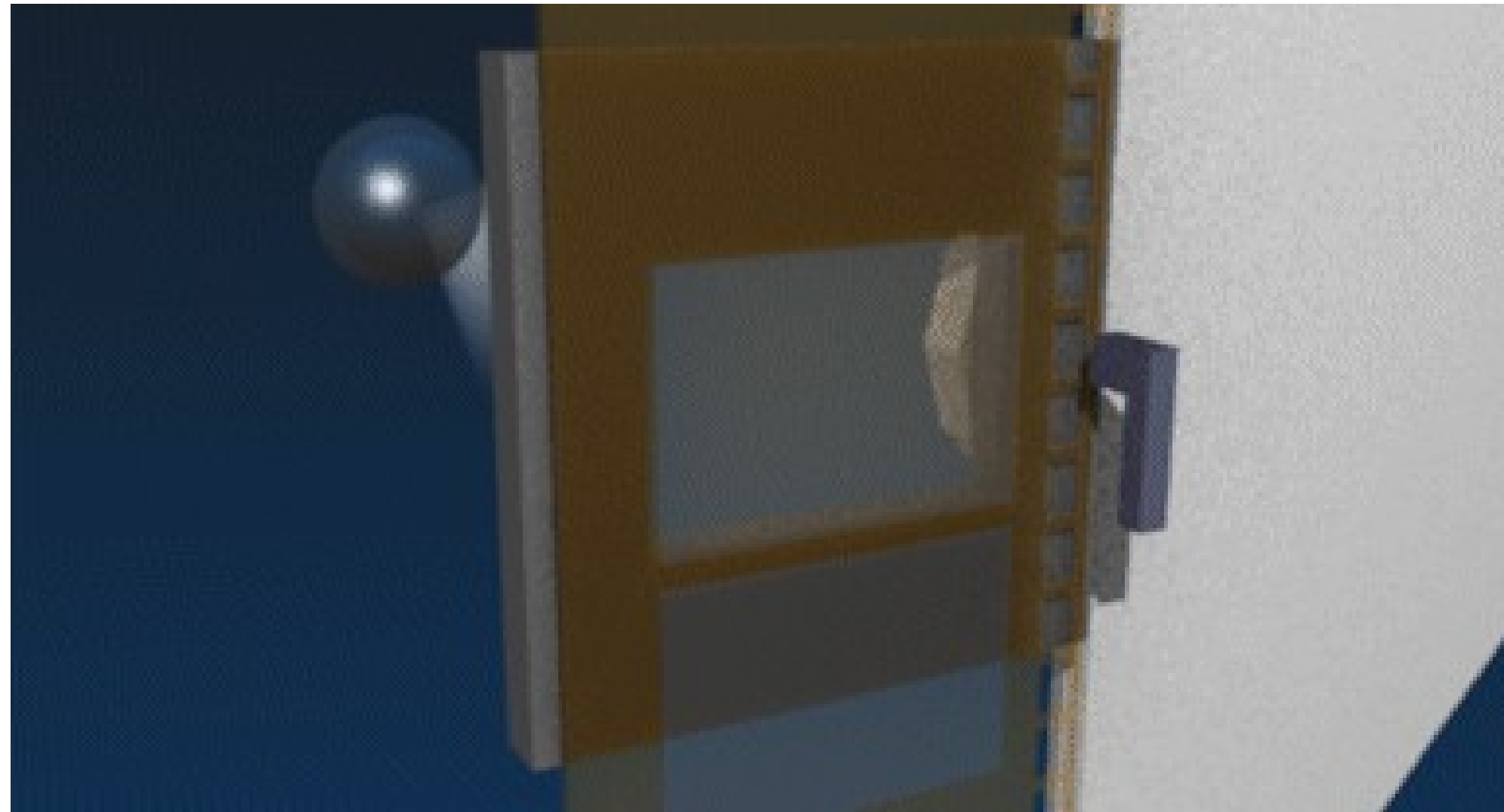


Normal motion blur



Maximum motion blur (smooth motion)





## Old cinema rotary shutter

- Controls motion blur
- Normal value is  $180^\circ$
- Could be recalculated according to FPS



STBY

29.97P

21:41:20.05 STBY

29.97P

21:41:20.

FPS



Shutter

1/2000

F 3.5 ISO 8000



Shutter

1/60

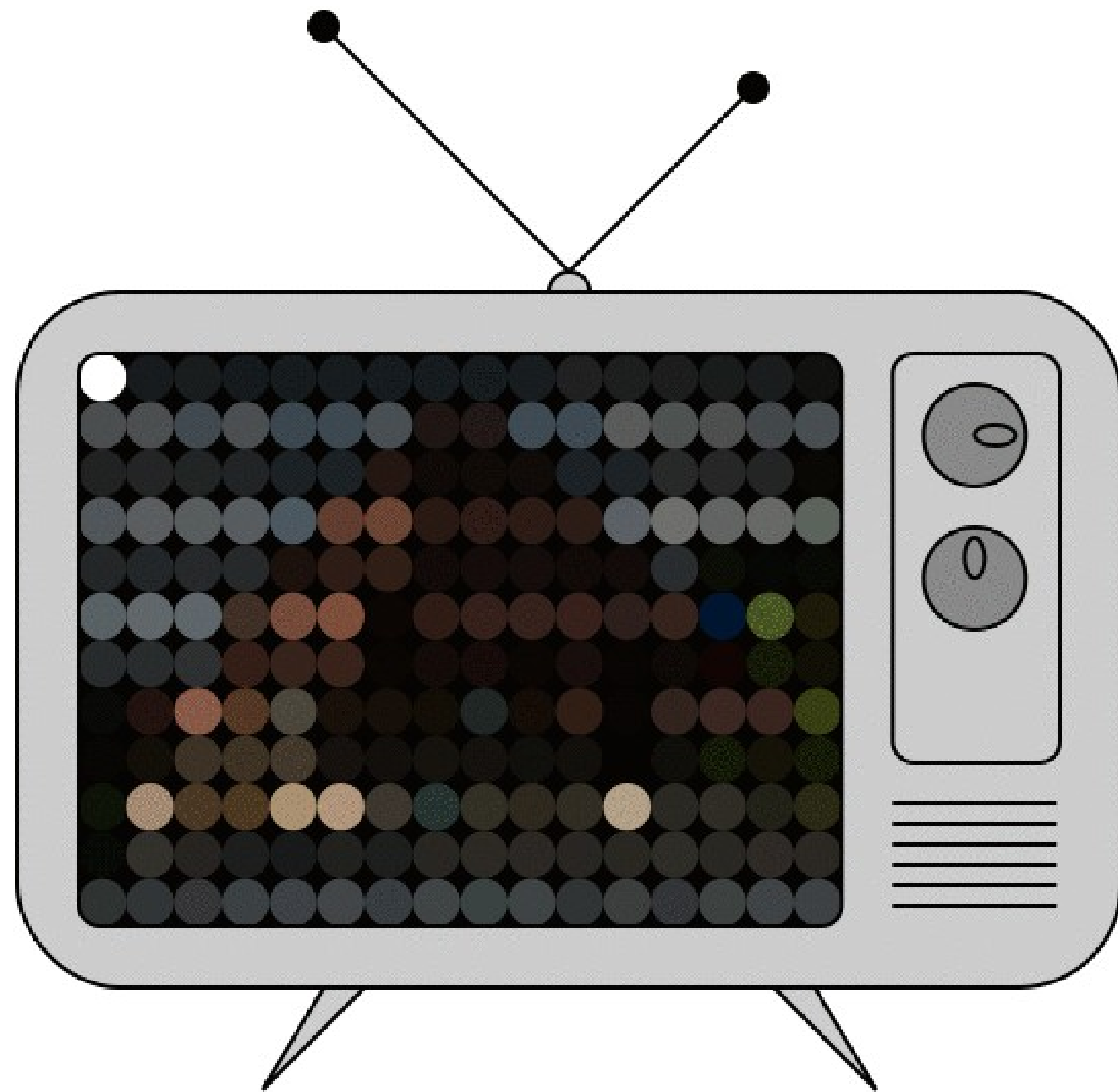
F 3.5 ISO 320







1. Why does sound matter?
2. Why does shutter matter?
3. Interlaced videos
4. Frame Rate Conversion
5. How to preserve quality?



## Legacy technology

- Invented in 1927
- Beautiful hardware hack
- Requires pixel accuracy
- Does not work in the Internet

# Interlaces videos

1. 2 fields per frame
2. Increases temporal resolution
3. Increases spartial resolution
4. Works fine on old CRT TVs

# Why should you care?

1

---

Camera shutter refers  
to 50FPS

2

---

Deinterlace to 50FPS  
to prevent stuttering

3

---

Obey field order





▶ **A** 973 min **MP4** **MP4** **Remote**

STBY

59.94P

21:41:20.05 P

28 mm

**AF**   
**NORM1**  
**CP** 



**LIM**



**FAN**



**K** 5880K  $\pm 0$ CC

F 3.5

ISO 8000

1/2000







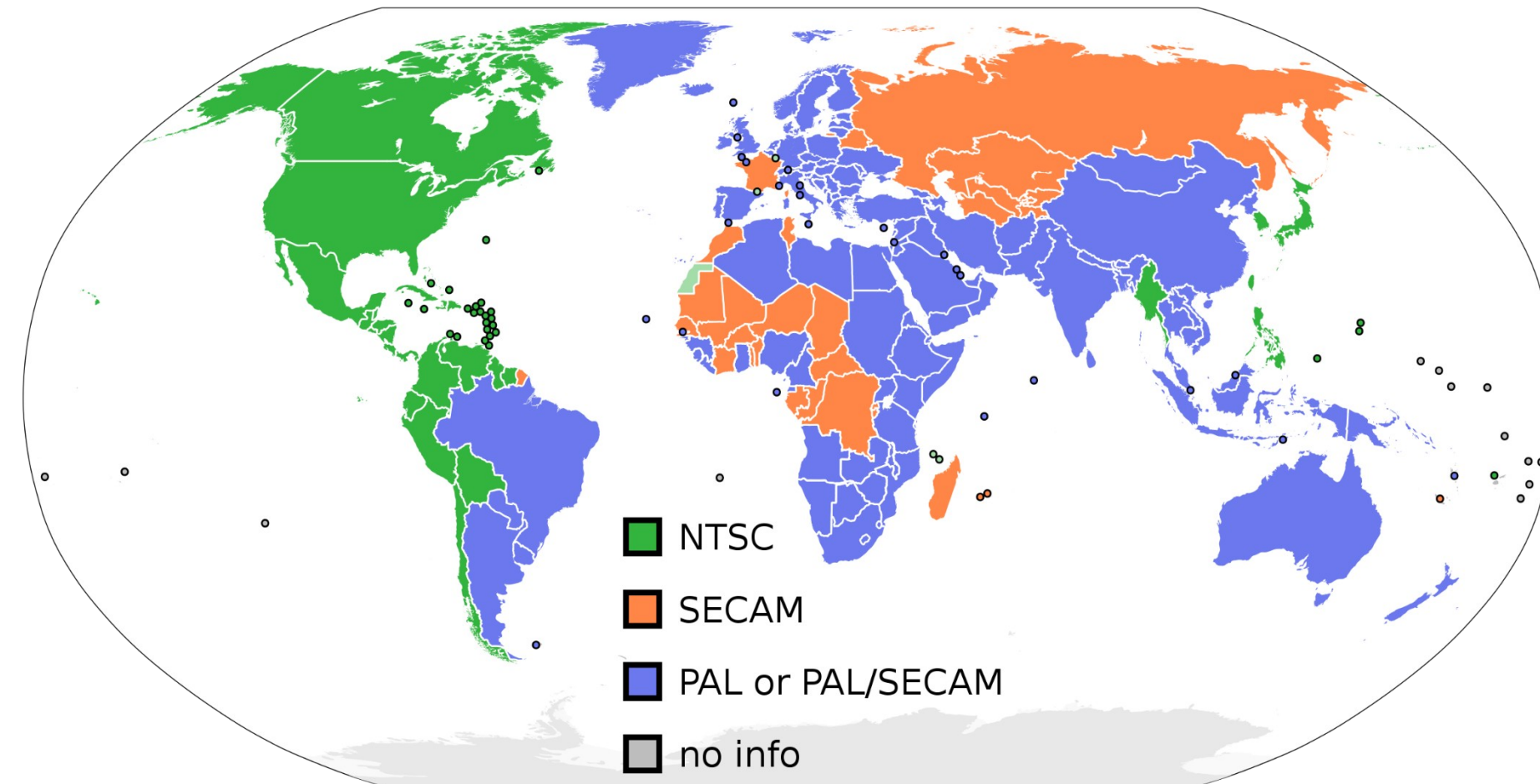


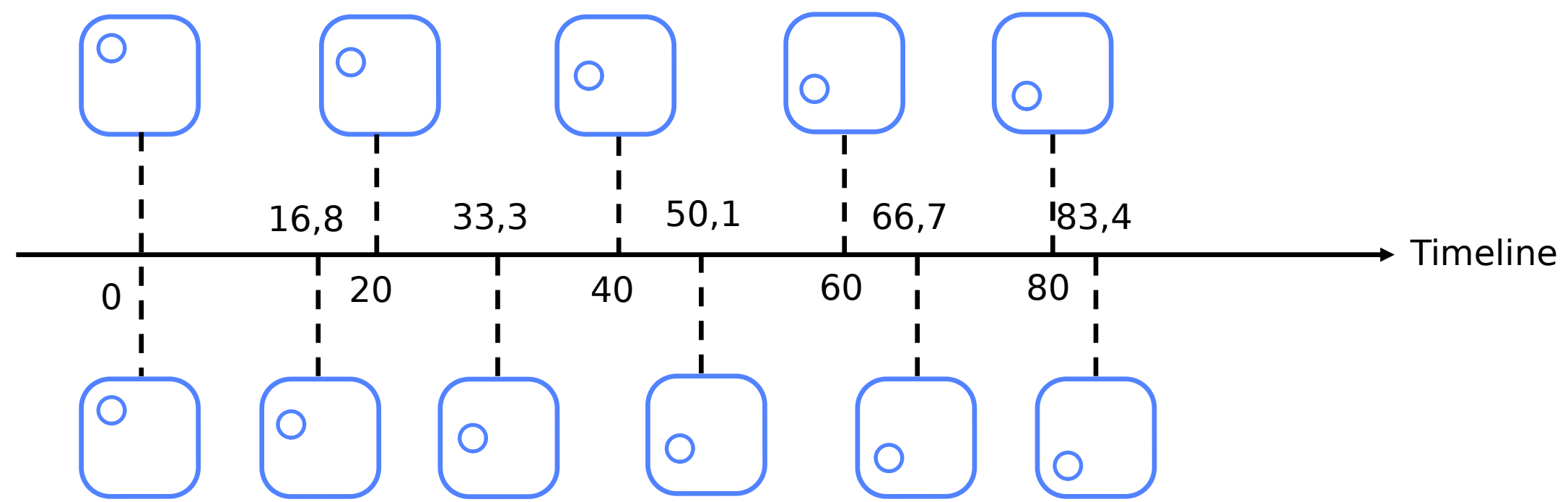
1. Why does sound matter?
2. Why does shutter matter?
3. Interlaced videos
4. Frame Rate Conversion
5. How to preserve quality?

Avoid if you can

## Map of FPSs

- NTSC is 59.94FPS (60i)
- SECAM is 50FPS (50i)
- PAL is 50FPS (50i)





For each 5 frames of 50p video there is 6 frames of 60p video

Only 1 frame of each batch corresponds to the same timestamp

# Possible artifacts

1

---

Ghosting

2

---

Stuttering

3

---

Blurred fast moving  
objects





▶ **A** 227 min **MP4** **MP4** Remote

STBY

50.00P

21:41:20:05 P

YCC420 8 bit  
3840x2160

30 mm

AF

i0

NORM1

CP

LIM



1 2

FAN



**K** 5880K  $\pm 0$ CC

F 3.5

ISO 400

1/100



1. Why does sound matter?
2. Why does shutter matter?
3. Interlaced videos
4. Frame Rate Conversion
5. How to preserve quality?

# How to save quality

1

---

Get all video in one system  
of coordinates

FPS, size, audio discretization  
rate

2

---

Respect timestamps from  
source

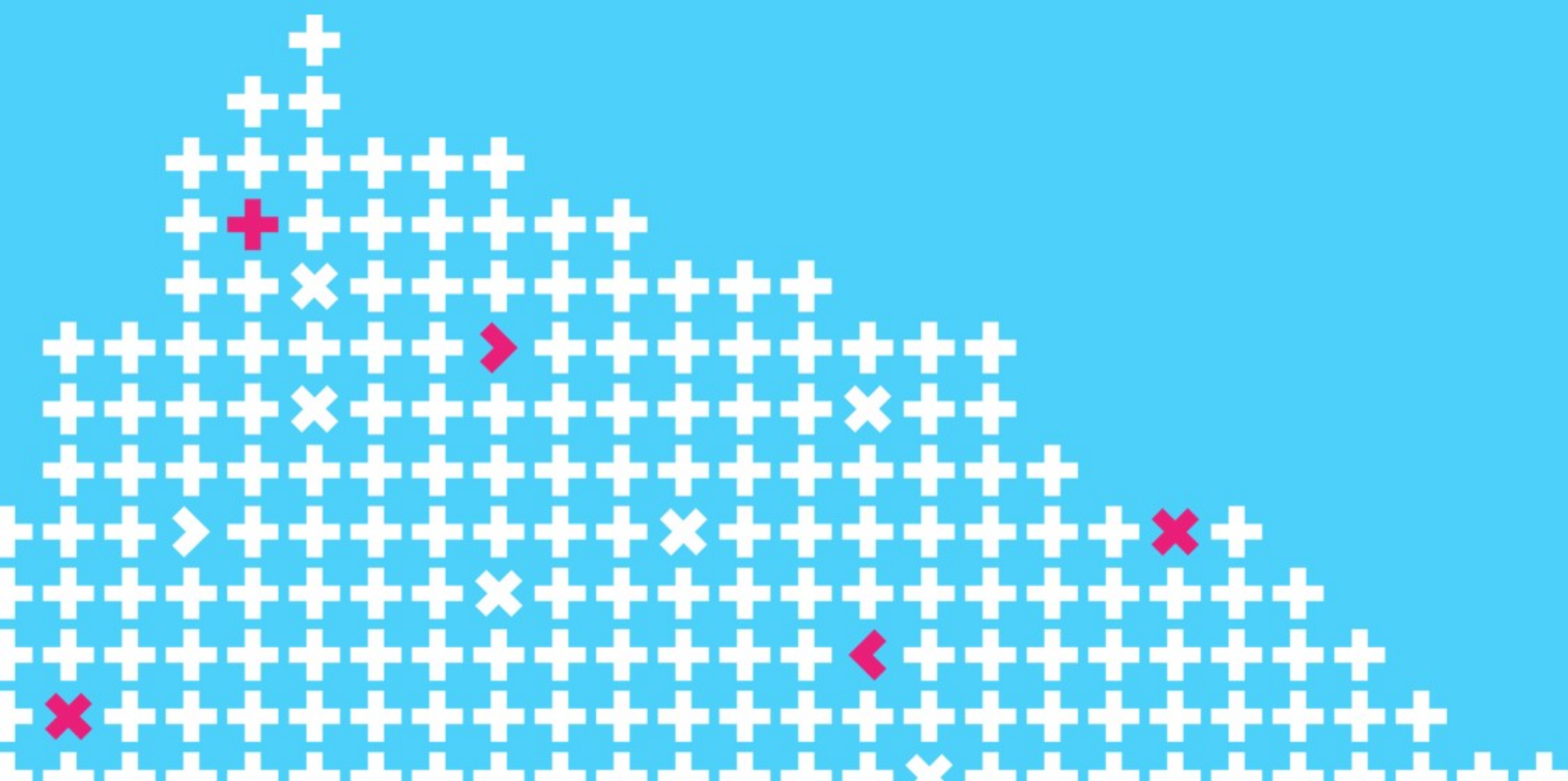
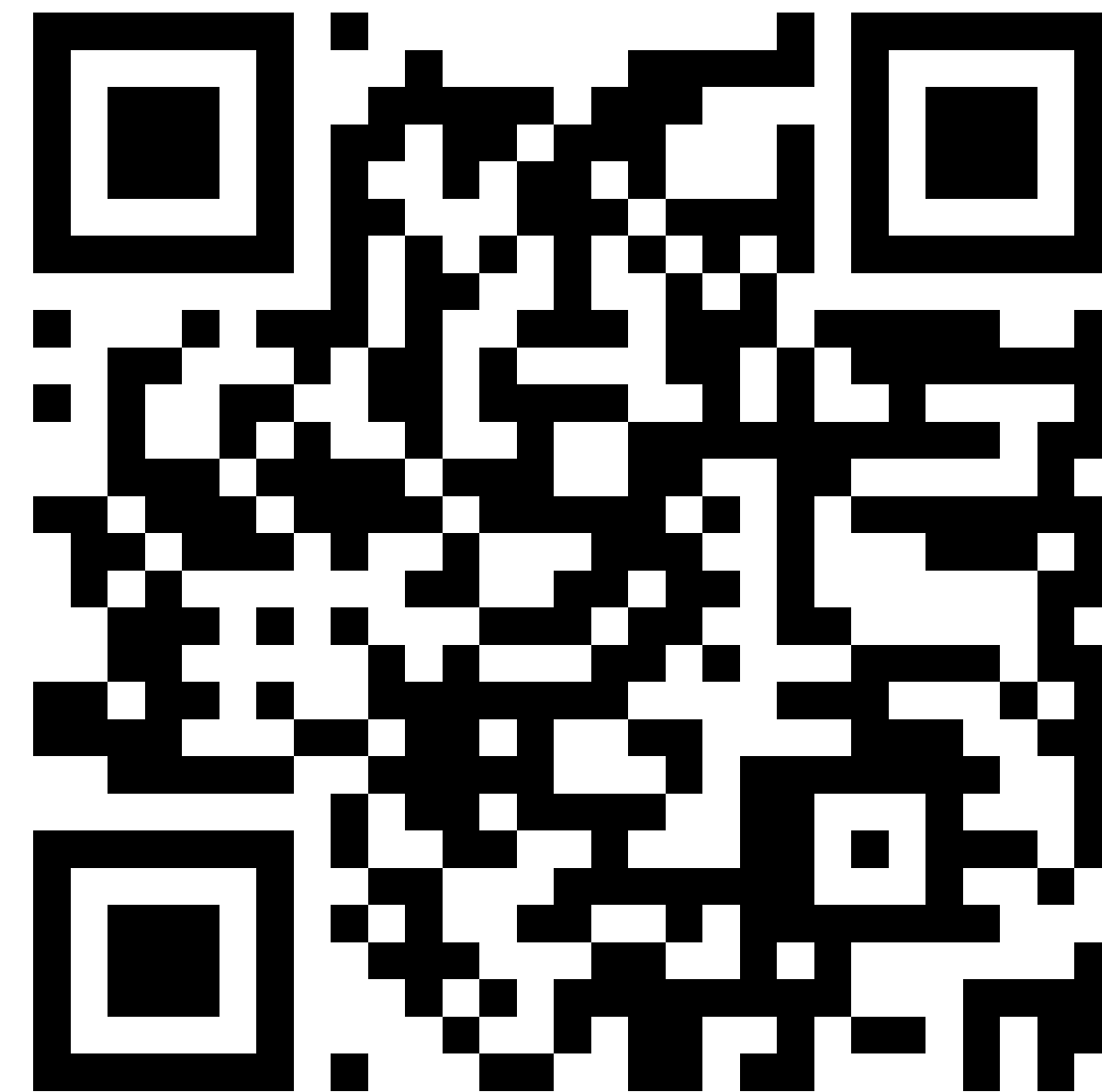
3

---

Watch result with your  
own eyes

# Leave your feedback!

You can rate the talk and  
give a feedback on what  
you've liked or what  
could be improved



Co-organizer

**Yandex**